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Dr. John C. Bugher, M.D., Director Division of Biology and Medicine May 13, 1954

Gordon M. Dunning, Health Physicist Biophysics Branch, Division of Biology and Medicine

ESTIMATED RADIATION DOSE TO THIROID OF NATIVES FROM RONGELAP

This memorandum is in reply to your request for an estimate of additional doses to the thyroid of the Rongelap natives due to the fact that tellurium, as a precursor to iodine, may be present in the gut after ingestion of fallout naterial. The tellurium, in turn, might disintegrate into radioactive iodine while in the gut, with subsequent deposition of the iodine in the thyroid.

There are some 17 radioactive isotopes of tellurium but only 7 of these are produced in fission. Of these, 6 are not of interest (4 have too short a half-life, 1 leads to stable iodine-127 and 1 leads to iodine-129 with a half-life of 2-4 x 107 years). The remaining radioisotope is tellurium-132, with a half-life of 77 hours leading to iodine-132 with a half-life of 2.4 hours. (Incidentally there is no tellium precursor that is of interest here.)

Without having the original data of LASL I have accepted their estimate that there were ingested and/or inhaled the products of  $5 \times 10^{13}$  fissions, assumed they were all ingested, and then proceeded to calculate the dose to the thyroid from (a)  $I^{131}$  (b) each shortlyed iodine isotope of interest and (c) the added dose coming from  $T^{132}-I^{132}$ . The calculations show that  $T^{132}-I^{132}$  will produce an added dosage of about 26%.

The best estimated percentage absorption and deposition of iodine is yet to be determined. The best estimate I can turn up to date is still the 20% quoted in NBS Handbook 52. However, I will continue to search for additional information. In the meantime the table below indicates the magnitude of doses to the thyroid if one assumes 20, 50, and 100% absorption and deposition. Incidentally, it may be noted that the calculations below based on 20% (the number assumed by LASL) show estimated doses to the thyroid from I<sup>131</sup> and from shorter lived iodine isotopes to be in good agreement with those estimated by LASL, i.e., 50 reps for I<sup>131</sup> and 80 reps for shortlived iodine isotopes.

SINGLE REVIEW AUTHORIZED BY.

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## DOSE TO THIROID (REPS)

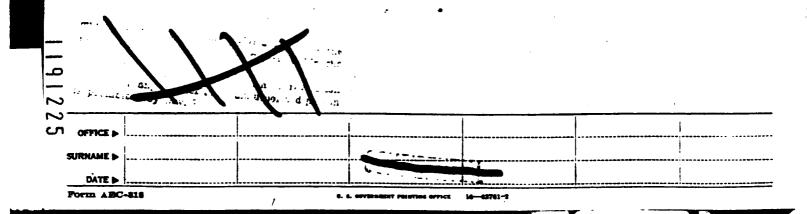
	Assuming 100% Retention		Assuming 50% Retention		Assuming 20% Retention	
131 1132 1133 1135 1132(Te <sup>132</sup> )	255 27* 370 60 185* 897*	255 (54)** 370 60 (370)** (1109)**	128 11/* 185 30 93* 150*	128 (27)** 185 30 (185)** (555)**	51 5* 74 12 37* 189*	51 (10)** 74 12 (74)** (221)**

= If assume that one-half of the I<sup>132</sup> (half-life 2.4 hours) present in the gut is deposited in the thyroid.

deposited in the thyroid.

## If assume all of the I<sup>132</sup> (half-life 2.4 hours) present in the gut is deposited in thyroid.

Most probable estimate of ratio of doses to thyroid is:



#### ANNEX

### Calculations of Dose to Thyroid

#### **T131**

Assume: inhalation and/or ingestion of  $5 \times 10^{13}$ 

At D  $\neq$  1 there are 0.017 d/m/10 000 fissions

or  $8.5 \times 10^7 \, d/m/5 \times 10^{13} \, \text{fissions}$ 

or 38.3 pc intake of Il31

or 1.4 x  $10^{12}$  atoms intake of  $I^{131}$ 

(Average energy 0.22 Mev)

Dose (reps) = 
$$\frac{(1.35 \times 10^{12})^{4}(0.22)(1.6 \times 10^{-6})}{(20)(93)}$$
 = 255 reps

\* Correction for biological decay.

# <sub>T</sub>132

Assume: inhalation and/or ingestion of 5 x  $10^{13}$  fissions At D  $\neq$  1, I<sup>132</sup> intake is 1.1 x  $10^{11}$  atoms

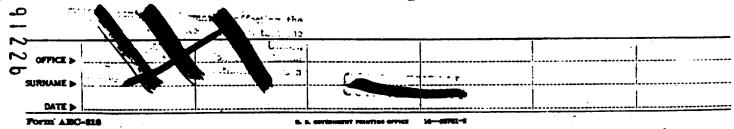
The average mean energy of I<sup>132</sup> is about 0.55 mev or 2.5 times that of I<sup>131</sup>.

Thus, the energy equivalent to I131 would be

 $(1.1 \times 10^{11})(2.5) = 2.75 \times 10^{11}$  atoms of I<sup>131</sup>

However, due to the short half-life of  $I^{132}$  (2.4 hrs) assume that the energy equivalent of 1.5 x  $10^{11}$  atoms of  $I^{131}$  reaches the thyroid.

Thus, the ratio of doses  $\frac{131}{132} = 9.0$ 



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**I**133

Assume: inhalation and/or ingestion of 5 x 10<sup>13</sup> fissions
At D / 1, I<sup>133</sup> intake is 1.2h x 10<sup>12</sup> atoms
The average mean energy of I<sup>133</sup> is about 0.36 or 163 times that of I<sup>131</sup>.

Thus, the ratio of doses I<sup>131</sup> ~ 0.7

**1135** 

Assume: inhalation and/or ingestion of 5 x  $10^{13}$  fissions At D  $\neq$  1, I<sup>135</sup> intake is 2.36 x  $10^{11}$  atoms.

The average mean energy of I<sup>135</sup> is about 0.3 meV or 1.36 that of I<sup>131</sup>.

Thus, the energy equivalent to  $I^{131}$  would be  $(2.36 \times 10^{11})(1.36) = 3.2 \times 10^{11} \text{ atoms of } I^{131} \text{ energy equivalent.}$ 

Thus, ratio of doses  $\frac{131}{135} \approx 4.2$ 

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Assume: inhalation and/or ingestion of  $5 \times 10^{13}$  fissions.

At B / 1, Tel32 intake 100 pc

or 1.5 x 10<sup>12</sup> atoms

Assume: the time spent in the gut is 77 hrs.

Then, 7.3 x  $10^{11}$  atoms of  $Te^{132}$  will have disintegrated into 7.3 x  $10^{11}$  atoms of  $I^{132}$ .

The average mean energy of I is about 0.55 Mev or 2.5 times that of I 131.

Thus, the energy equivalent to I would be

 $(7.3 \times 10^{11})(2.5) = 1.8 \times 10^{12}$  atoms of I<sup>131</sup>.

However, due to the short half-life of  $I^{132}$  (2.4 hrs), assume that only the energy equivalent of 1 x  $10^{12}$  atoms of  $I^{131}$  reaches the thyroid.

Thus, the ratio of doses  $\frac{131}{132(16132)} \approx 1.4$ .

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